

Mammal Inventory of Alaska's National Parks and Preserves

Kenai Fjords National Park

Annual Report 2003

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January 2004

**National Park Service
Southwest Alaska Network
Inventory and Monitoring Program**

**Cooperative Agreement H8R07010001
Task Agreement J8R07030002
Funding Source: National Park Service, SW Alaska Network**

File Name: CookJ_2004_KEFJ_Mammals2003AnnRep_040623.doc

Recommended Citation:

Cook, J. A., and S. O. MacDonald. 2004. Mammal inventory of Alaska's National Parks and Preserves: Kenai Fjords National Park. Southwest Alaska Network Inventory and Monitoring Program, USDI National Park Service, Anchorage, AK. 34 pp.

Theme Keywords:

Mammals, inventory, small mammals, museum specimens

Placename Keywords:

Alaska, Kenai Fjords National Park, KEFJ, Southwest Alaska Network, SWAN, Kenai Peninsula

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Abstract

This report details the inventory of mammals in Kenai Fjords National Park (KEFJ) between 7 and 28 July 2003 as part of a cooperative effort of the Beringian Coevolution Project at the Museum of Southwestern Biology, University of New Mexico and the Inventory and Monitoring Program of the National Park Service of Alaska.

We begin the process of documenting the approximately 26 species of land mammals that occur or probably occur in the park, with a primary focus on small mammals (i.e., shrews, bats, voles, lemmings, weasels, porcupine, squirrels, and hare).

This survey resulted in 748 primary specimens of four small mammal species. Across all localities sampled, cinereus shrew (*Sorex cinereus*) and northern red-backed vole (*Clethrionomys rutilus*) were the most frequently captured species, comprising over 88% of all animals sampled.

This inventory provided the first specimens of cinereus shrew, montane shrew (*Sorex monticolus*), northern red-backed vole, and tundra vole (*Microtus oeconomus*) from KEFJ. Further sampling effort is still needed to add pygmy shrew (*Sorex hoyi*), singing vole (*Microtus miurus*), northern bog lemming (*Synaptomys borealis*), muskrat (*Ondatra zibethicus*), hoary marmot (*Marmota caligata*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), porcupine (*Erethizon dorsatum*), ermine (*Mustela erminea*), and little brown bat (*Myotis lucifugus*) to the park's list of specimen-documented species.

The findings from this study, when combined with specimen information gathered from a review of holdings in other major collections, bring the total number of documented small mammal species in KEFJ to 4 of 14 potential species, or 29% coverage.

The specific products of this inventory begin building a collection of well-prepared, well-documented, and diverse preparations of mammal specimens and associated materials (tissues, parasites, fecal samples, digestive tracts) for taxonomic, zoogeographic, ecological, genetic, parasitological, epidemiological, and other research and management purposes.

Executive Summary

This inventory project was a cooperative effort of the Beringian Coevolution Project (BCP) at Idaho State University (and now University of New Mexico), Kenai Fjords National Park and the Inventory and Monitoring Program of the National Park Service (NPS) of Alaska. Other participating institutions included the University of Alaska Museum (UAM) and USDA National Parasite Collection. BCP personnel involved in this field effort were Stephen MacDonald, Eric Waltari, Anson Koehler, Carlee Hengel, and Joseph Cook, Nella Cook, and Felipe Cook. Lucretia Fairchild (NPS) also participated in some of the field collecting.

This report details the inventory of the mammals at 10 general locations in Kenai Fjords National Park (KEFJ) between 7 July and 28 July 2003. We begin the process of documenting the approximately 26 species of land mammals that occur or probably occur in the Park, with a primary focus on small mammals (i.e., shrews, bats, voles, lemmings, weasels, porcupine, squirrels, and hares).

The specific products of this inventory include a permit-limited collection of well-documented, and diverse preparations of mammal specimens and associated materials (tissues, parasites, fecal samples, digestive tracts). This survey (92 person-days and 4573 trap nights of collecting effort) resulted in a total 748 primary specimens (excluding embryos) comprising four small mammal species. All voucher specimens of mammals were deposited in the University of Alaska Museum.

Across all localities, a shrew (cinereus shrew) and a murid rodent (northern red-backed vole) were the most frequently sampled species (458 and 203 specimens, respectively), comprising over 88% of all specimens collected.

The findings from this study, when combined with specimen information gathered from a review of holdings in other major collections, bring the total number of documented small mammal species in KEFJ to 4 of 14 potential species, or 29% coverage.

This inventory provided the first specimens for four small mammal species in KEFJ (cinereus shrew, montane shrew, northern red-backed vole, and tundra vole). Further sampling effort (particularly in the Upper Nuka River and Resurrection River areas) is still needed to add pygmy shrew, singing vole, northern bog lemming, muskrat, hoary marmot, red squirrel, snowshoe hare, porcupine, ermine, and little brown bat to the Park's list of specimen-documented species.

Perspectives on the value of the specimen-based approach to inventory and monitoring are discussed, and recommendations for future efforts in KEFJ and the Kenai Peninsula are enumerated.

Introduction

This report details an inventory of the small mammals in Kenai Fjords National Park (KEFJ) between 7 and 28 July 2003. The Beringian Coevolution Project (BCP), previously centered at Idaho State University (ISU), but now at the Museum of Southwestern Biology (MSB), University of New Mexico, worked collaboratively with the Inventory and Monitoring Program of the National Park Service, Alaska, and the University of Alaska Museum (UAM) to conduct an inventory at selected sites in KEFJ to document the occurrence, relative abundance, and general habitat affinities of the small mammal fauna, namely, the shrews, voles, lemmings, weasels, porcupine, squirrels, and hares (Table 1).

This effort is beginning to provide a series and variety of permanently preserved materials and associated data sets for taxonomic, zoogeographic, ecological, genetic, parasitological, epidemiological, and other research and management purposes. Because the fauna of Alaska is the least studied of the continent, these NPS inventories are an important contribution to our understanding of mammalian diversity.

The mammal fauna of KEFJ is heavily influenced by past and present glaciations. The dynamic geologic and climatic history that this region (Elias 1995) has experienced provides an important context for understanding the fauna of KEFJ which is comprised of immigrant species from diverse regions. Well documented species distributions will also provide a context for interpreting the magnitude of the impact from predicted climate change at these northern latitudes (Parmesan and Yohe 2003, Root et al, 2003).

Methods and Materials

Review of Museum Collections

Documentation of species' occurrence in KEFJ was complemented by a review of specimen holdings at the University of Alaska Museum (UAM) and other major collections, primarily the U.S. National Museum (USNM). Scientific and common names of mammals used in this report follow Wilson and Reeder (1993) and Wilson and Cole (2000), respectively. Vegetation classification generally follows Viereck et al. (1992).

Field Studies

Between 7 and 28 July 2003, the BCP field crew sampled 10 locations in KEFJ (Figure 1) for a total of 92 person-days and 4573 trap nights of collecting effort (Table 2) on 34 trapline transects (Table 3). These sampling areas were located along the length of the Park in a variety of habitats and elevations. Logistical support, including our shared use of the MV Serac, was provided by the National Park Service.

The BCP field crew included Stephen MacDonald, Eric Waltari, Anson Koehler, and Carlee Hengel. Joseph Cook, Nella Cook, Felipe Cook, and Lucretia Fairchild also participated in some of the field collecting.

Our collecting strategy was designed to maximize (within the limits set by our permits) the number and diversity of samples by using a variety of methods in available habitats. While particular effort was made to sample rare or undocumented shrews and murid rodents, the sampling methods used also allowed us to evaluate the occurrence and relative abundance of the more common species.

Diversity of captured specimens was maximized by utilizing a combination of Museum Special snap traps and pitfall traps (44 oz. plastic drinking cups). No bats, weasels, marmots, squirrels, porcupines, or hares, if encountered, were sampled due to permit restrictions.

Traplines for shrews and voles were set in the range of available habitats and ecotones in each study location (Table 3). Traplines typically consisted of 20 or more trap stations per line, with stations spaced 8-10 m apart. At each station, two snap traps or one snap trap and one pitfall trap were typically set within 2 m of each station point. The snap traps were baited with a mixture of rolled oats and peanut butter; pitfall traps were buried flush with the ground and left unbaited. Traps were usually set in the late afternoon and checked the following morning. Productive lines were usually kept in operation for two or more nights.

Field Locations

Upper Nuka River (Seldovia Quad; 59.6167N, 150.6667W [NAD27]; 300-330 m elevations). 8-10 July 2003. Several crew members established a spike camp above treeline in this narrow passageway through the Kenai Mountains that separates the wet Gulf Coast subregion from Cook Inlet and the drier lowlands of western Kenai Peninsula. A total of 63 animals, comprising four species were sampled here during two nights of trapping.

North Arm, Nuka Bay (Seldovia Quad; 59.55N, 150.5167W [NAD27]; low coastal elevations). 7-11 July 2003. Base camp was the NPS cabin on east side North Arm. From here we sampled 74 small mammals, comprising three species in a variety of meadow and forest habitats.

Shelter Cove, Beauty Bay (Seldovia Quad; 59.5167N, 150.6333W [NAD27]; low coastal elevations). 9-10 July 2003. Traplines were run for one night (215 trapnights of effort) in meadow and forest-edge habitat at the head of Shelter Cove near the mouth of the Nuka River. A total of 43 specimens of three species were collected.

Delight Spit (Seldovia Quad; 67.1N, 154.2667W [NAD27]; low coastal elevations). 11-15 July 2003. We collected a total of 80 small mammals of three

species in estuarine meadow and adjacent forest habitats in close vicinity to the NPS cabin located on East Arm of Nuka Bay. Black bears proved to be a nuisance at the cabin and along some of our lines in the area.

Delight Lake (Seldovia Quad; 59.5333N, 150.3W [NAD27]; 5-10 elevations). 11-15 July 2003. Several traplines established in lowland forest and riparian habitats in the vicinity of Delight Lake resulted in the capture of 77 small mammal specimens of three species.

Paguna Arm (Seldovia Quad; 59.6833N, 150.1333W [NAD27]; 2-130 m elevations). 16-18 July 2003. Working by skiff from the NPS vessel, the Serac, we sampled a diversity of meadow, scrub and forest habitats at the head of the bay and near the mouth of a major stream that flows into the east side of Paguna Bay about 2.5 km farther to the south. A total of 112 specimens comprising four species were documented at these two sites.

Crater Bay (Blying Sound Quad; 59.7167N, 149.7667W [NAD27]; 5-200 m elevations). 18-19 July 2003. We sampled a total of 12 small mammals of three species during our overnight anchorage on the west side of Harris Peninsula. Lines were set in mature spruce forest on the south side of the bay, as well as upslope in alpine tundra habitats to the north.

Northwestern Lagoon (Blying Sound Quad; 59.7667N, 149.9167W [NAD27]; lowland coastal elevations). 19-20 July 2003. A total of 30 specimens comprising three species were sampled during one night of trapping in this flat, lowland area on the north side of Northwestern Lagoon.

Aialik Bay (Blying Sound Quad; 59.8167N, 149.6333W [NAD27]; 2-50 m elevations). 20-22 July 2003. A number of traplines were established at the heads of Tooth Cove and the cove immediately south of Tooth Cove ("South Tooth Cove"). In two nights of trapping these lines produced a total of 123 specimens consisting of three small mammal species.

Resurrection River (Seward Quad; 60.2833N, 149.7W [NAD27]; 150-170 m elevations). 25-28 July 2003. Our crew was helicoptered upvalley from Seward airport along a flooding Resurrection River to an upland meadow area surrounded by spruce forest approximately 2.5 km upriver from the mouth of Placer Creek near the extreme northern end of the Park that transitions into the interior lowlands of the Kenai Peninsula. We sampled a total of 134 small mammals of three species at this locality.

Specimen Processing

Each animal sampled was preserved as a scientific specimen in the form of a skeletal preparation or as a whole bodied fluid (ETOH) preparation. A tank of liquid nitrogen was carried in the field to preserve tissues (heart, liver, kidney,

spleen, and lung) and embryos. These frozen specimens were transferred to ultra-low temperature freezers at UAM and MSB and are archived at -70° C. We preserved ectoparasites, endoparasites and feces samples from many of the mammals collected. These data sets will be used to address epidemiological, coevolutionary, taxonomic, and biogeographic questions. Intestinal tracts from shrews were also preserved. A loose-leaf notebook containing field protocols allowed us to rigorously document and preserve specimens.

All mammal specimens from this study have been accessioned into the mammal collection at UAM and are in process of curation. Detailed data on all specimens will be available in the UAM database and accessible on its website (<http://www.uaf.edu/museum/mammal>). The primary voucher specimens from this study were accessioned into the mammal collection at UAM and are in process of curation. The samples of endoparasite are now at the US National Parasite Collection in Beltsville, MD and the Vantaa Research Centre in Vantaa, Finland. The samples of ectoparasites are being disbursed to qualified experts from MSB.

Results and Discussion

Inventory Results

The specific products of this inventory include a modest collection of well-prepared, well-documented, and diverse preparations of mammal specimens and associated materials (tissues, parasites, fecal samples, digestive tracts). A total of 748 small mammal specimens (excluding embryos) was archived from 10 base localities (Table 2).

Only four species of small mammals were sampled in this study. Among these, the cinereus shrew, was particularly abundant, followed distantly by red-backed vole, montane shrew, and tundra vole (Figure 2).

This study documented four of the Park's 14 potential small mammal species, or 29% coverage.

Species Accounts

The following accounts summarize information on each species of land mammal known or suspected to occur in KEFJ (Table 1a; for context, a checklist of mammals for the entire Kenai Peninsula see Table 1b). An asterisk (*) indicates that species were observed but not collected in this study. A question mark (?) indicates a species of possible occurrence but of unknown status.

Not included in these accounts are marine mammals we encountered during this study, namely sea otter (*Enhydra lutris*), harbor seal (*Phoca vitulina*), humpbacked whale (*Megaptera novaeangliae*), Dall's porpoise (*Phocoenoides*

dalli), and a recent report (B. Rice, pers. com. 2003) of approximately 100 Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) in Aialik Bay.

No amphibians were found within the KEFJ. We did, however, see wood frogs (*Rana sylvatica*) elsewhere on the Peninsula near Sterling, and had several people report sighting wood frogs close to the Park near Seward.

Order **INSECTIVORA**—Shrews
Family **Soricidae**

Sorex cinereus, cinereus shrew

We found this shrew to be numerous and the dominant small mammal at all locations and on all traplines. They were more or less evenly distributed across all vegetation types sampled. The cinereus shrew is a dominant and periodically abundant species throughout its broad range (Nagorsen 1996).

Sorex hoyi, pygmy shrew

We did not find pygmy shrew in KEFJ, however, this species was documented on the Kenai Peninsula near Seldovia and Homer in 1903 (AMNH; Allen 1904) and 100 years later by us at two wetland localities near Sterling (IF 12845, IF 13038) prior to and following our field work in the Park.

Sorex monticolus, montane shrew

A relatively low number (N = 57) of montane shrews was collected at 8 of 10 localities in a variety of scrub, herbaceous, and forest habitats. Montane shrews from the Kenai Peninsula are referable to *S. m. shumaginensis* of southcentral (excluding Prince William Sound populations) and western Alaska (Alexander 1996). Based on skull variation, Alexander (1996) found some shrews from the Kenai Peninsula slightly divergent from those composing the remainder of the mainland population.

Order **CHIROPTERA**—Bats
Family **Vespertilionidae**

Myotis lucifugus, little brown bat

No bats were seen during our stay in KEFJ. Specimens referable to this species have been collected elsewhere on the Kenai Peninsula (UAM), and A. Wright (NPS, pers. com. 2003) reported seeing bats on several occasions in the vicinity of Exit Glacier.

Order **CARNIVORA**—Carnivores
Family **Canidae**

**Canis latrans*, coyote

Coyotes were seen and heard at Delight Spit and Delight Lake. Tracks were also noted at Shelter Cove. Sightings of this species elsewhere in the Park by NPS personnel are from the east side of Aialik Peninsula and along the Resurrection River near Exit Glacier. Specimens have been preserved from a number of locations on the Kenai Peninsula (UAM), but none from KEFJ.

Canis lupus, wolf

No wolves or their sign were noted during this study. This species has been reported from the Resurrection River area along the northeastern boundary of the Park (B. Rice, A. Wright-NPS, pers. com. 2003). No specimens have been preserved.

Wolves disappeared from the Kenai Peninsula shortly after 1900 (about the time caribou were eliminated). They reappeared in the mid-1960s and by the early 1970s were distributed over most of the peninsula (ADFG 1973, Peterson et al. 1984).

? *Vulpes vulpes*, red fox

We did not encounter nor hear of any red foxes ever being seen in the Park. This species is said to be sparse on the Peninsula, with it occurring occasionally close to the Park in the far upper reaches of Resurrection River (ADFG 1978). There are a small number of fox specimens from the Kenai Peninsula at the USNM, including the type specimen of the endemic form, *V. v. kenaiensis* (Hall 1981).

Family **Felidae**

Lynx canadensis, Canada lynx

Lynxes are occasionally seen in the Resurrection River area of the Park (A. Wright-NPS, pers. com.). We found no evidence of their presence during our stay in the area. Several specimens from other localities on the Peninsula have been preserved (UAM, USNM).

Family **Mustelidae**

**Gulo gulo*, wolverine

We encountered the tracks of a wolverine at Paguna Arm and Northwestern Lagoon. Past sightings of this wide-ranging species by NPS personnel are from Taroka Arm, Exit Glacier, and far out on the ice field above Exit Glacier. No specimens of this species have been preserved from KEFJ. The subspecies *G. g. katschemakensis* is confined to the Kenai Peninsula (Hall 1981). Schreiber et al. (1989) suggested that the taxonomic status of this endemic subspecies is in need of clarification. In their recent study examining genetic structure across populations in northwestern North America, Tomasik and Cook (submitted) found wolverines from the Kenai Peninsula somewhat distinctive but not enough, in their view, to support subspecies status for this population.

**Lontra canadensis*, northern river otter

River otters or their signs were noted along the coast of KEFJ at Delight Spit, Paguna Arm, and Northwestern Lagoon. No specimens have been preserved from the Park.

Martes americana, American marten

Marten are apparently rare on the Kenai Peninsula (ADFG 1978). Reports from NPS personnel of marten in KEFJ were limited to areas along the Resurrection River (B. Rice, A. Wright, L. Fairchild-NPS, pers. com. 2003). No specimens have been preserved from the Park.

Mustela erminea, ermine

Ermynes were not encountered during this study, but we received a report of their occurrence in the vicinity of Exit Glacier (A. Wright, NPS, pers. com. 2003). UAM houses a single specimen from Day Harbor near Seward. No specimens are known from the Park.

**Mustela vison*, American mink

Sightings or sign of mink were noted North Arm, Delight Lake, and Northwestern Lagoon. The type locality of the southcentral and southwestern Alaska subspecies, *M. v. melampeplus* is "Kenai Peninsula." (Hall 1981). No museum specimen is known from the Park.

Family **Ursidae**

**Ursus americanus*, American black bear

Black bears were present, sometimes numerous, at most localities visited. The type locality of Kenai Peninsula's endemic subspecies, *U. a. perniger*, is the mountains south of Chugachik Bay, opposite Homer (Hall 1981). UAM houses a number of black bear specimens from the Kenai Peninsula but none from the Park.

Ursus arctos, brown bear

A lone brown bear was seen from the air just north of our spike camp in the upper Nuka River valley. Brown bears are occasionally seen near the mouth of Nuka River and in the Resurrection River area, including at Exit Glacier (B. Rice, I. Martin, A. Wright-NPS, pers. com. 2003). The upper Resurrection River was identified as a concentration feeding area for brown bears by ADFG (1973). No specimens have been preserved from this or any other area in KEFJ.

Order **ARTIODACTYLA**—Ungulates Family **Cervidae**

**Alces alces*, moose

A lone moose was seen from the air in the Upper Nuka River Valley, and old sign was observed at Shelter Cove just south of this river's mouth in Beauty Bay. This

area was also identified as an area of incursion by moose to the outer coast of KEFJ by ADFG (1973). No sign of moose was encountered again until the Resurrection River, where several moose were seen from the air during our flight upriver and their sign noted near Exit Glacier and in the vicinity of our camp north of Placer Creek. The Resurrection River Valley was identified by ADFG (1973) as a concentration area for moose during fall and winter.

? *Rangifer tarandus*, caribou

Caribou are limited in distribution to more northern areas of the Kenai Peninsula (ADFG 1973), where they were reintroduced beginning in 1965 from Nelchina stocks following their extirpation from the Peninsula around the turn of the last century (Spencer and Hakala 1964, Burris and McKnight 1973). It is unlikely that any would find their way as far south as KEFJ except as a rare visitor.

Family **Bovidae**

**Oreamnos americanus*, mountain goat

KEFJ provides prime habitat for mountain goats. They occur in the Kenai Mountains along both sides of the Harding Icefield (ADFG 1973). During this study we noted goats in the mountains north of Delight Lake and in the vicinity of Crater Bay on Harris Peninsula. Bud Rice (NPS, pers. com. 2003) provided previous goat sightings along the length of Aialik Peninsula with concentrations of animals near the base of the peninsula, as well as sightings near Callisto Head at the mouth of Resurrection Bay. No specimens of mountain goat have been preserved from KEFJ.

? *Ovis dalli*, Dall's sheep

Dall's sheep are found in the Kenai Mountains west and north of the Harding Icefield from the head of Kachemak Bay to Turnagain Arm (ADFG 1973). It is not known whether sheep from the southernmost herd near Bradley Lake ever venture as far south as the upper Nuka River and KEFJ.

Order **RODENTIA**—Rodents

Family **Sciuridae**

**Marmota caligata*, hoary marmot

Hoary marmots occur throughout the mountains of the Kenai Peninsula, including KEFJ. We noted this species at the head of Paguna Arm, above Crater Bay and Coleman Bay, and near tidewater at Tooth and "South Tooth" Coves. Marmots were also reported from the Exit Glacier area (A. Wright-NPS, pers. com. 2003). No specimens for future study have been preserved from the Park, but given the tremendous geographic variation and high levels of endemism reported for this species (Hall 1981), such an effort should be high priority.

**Tamiasciurus hudsonicus*, red squirrel

Red squirrels occur in forest habitats throughout the Park. Kenai Peninsula squirrels are considered a separate subspecies, *T. h. kenaiensis* (Hall 1981); however, there has not been a significant taxonomic revision of this species since Allen (1898). A study of geographic variation throughout its entire range is needed (Nagorsen 1990), but no specimens have been preserved from the Park.

Family **Castoridae**

**Castor canadensis*, American beaver

We noted the presence of beavers only along the Resurrection River. This species has yet to be vouchered with a specimen from KEFJ.

Family **Muridae**

Clethrionomys rutilus, northern red-backed vole

Red-backed voles were the second most frequently captured small mammal species in this study, but at no locality did we find them very numerous, suggesting they, like tundra voles, were at a relatively low population level in 2003. In outward appearance, the red-backed voles of KEFJ are distinctive, being relatively thin-tailed and dark in overall coloration with a varying proportion of our coastal samples possessing white chins, throat patches, and belly stripes of varied size and configuration (Figure 3).

Microtus miurus, singing vole

Singing voles occur above timberline on the western slopes of the Kenai Mountains (Allen 1902, 1903; Osgood 1901; Fuller 1981), but have yet to be documented in KEFJ. Concentrated but time-limited trapping efforts for this vole in the upper Nuka River area were unsuccessful. The many old *Microtus* runways seen in this area suggested there being a population crash of either singing or tundra voles within the past year.

Microtus oeconomus, tundra vole

Tundra voles were infrequently captured in herbaceous and scrub-herbaceous habitats at only four localities. In years of abundance, we expect this vole is usually more prevalent and widespread throughout the meadow and tundra habitats of the Park.

Ondatra zibethicus, muskrat

ADFG (1978) considered muskrats uncommon on the Kenai Peninsula and of only occasional occurrence along the Resurrection River at the northeastern boundary of the Park. No sightings or specimens from the Park have been reported.

Synaptomys borealis, northern bog lemming

Northern bog lemmings have been documented on the Kenai Peninsula west of the Kenai Mountains (Osgood 1901, Allen 1904, UAM) but not as yet in KEFJ. This species is often uncommon to rare and generally restricted to open habitats with a preference for damp meadows, marshes, bogs, and fens. Continued inventory efforts, particularly in the vicinity of the Resurrection River, may eventually document the occurrence of this lemming up within the Park.

Family **Erethizontidae**

**Erethizon dorsatum*, North American porcupine

Porcupines are probably rare but widespread in KEFJ. No porcupines were encountered during this study but fresh tracks were noted at Paguna Arm, and an old den site with numerous droppings was discovered under the shelter of a large boulder in mature forest at Crater Bay. Additional sightings of porcupines from NPS personnel were from Holgate Arm and Exit Glacier.

Order **LAGOMORPHA**—Pikas and Hares

Family **Leporidae**

Lepus americanus, snowshoe hare

We did not encounter snowshoe hares or their sign in this study; however, A. Wright (NPS, pers. com. 2003) reported hares present in the valley of the Resurrection River near Exit Glacier but that this population has been at a low for the past few years. ADFG (1978) considered the status of snowshoe hares on the Kenai Peninsula as generally uncommon.

Habitat Affinities

Habitats of small mammals are often defined by their association with particular plants (Hoffmeister 1986). Under the influences of the topography, soils, climate conditions, and other ecological factors, plants may be placed into distinct groups referred to as vegetative communities, associations, or types. Mammals can often be associated with particular plant communities (some at the macro-scale, most others and especially the smallest ones like the shrews to micro-habitat scales). Some species are restricted to few communities, others are found in many. The degree of a species' dominance in a particular vegetative community and its range across various communities often is related to varying population levels. Populations of small mammals of high latitudes often fluctuate dramatically from year to year and season to season. These shifts in abundance, along with dynamic interspecific interaction (particularly among congeneric species) suggest that long-term studies of small mammal communities will be required to carefully assess the particular affinities of each species.

In addition to vegetation, other features and factors may influence a species' distribution, including topography, soil types, snow and ice cover, availability of

food or pathogens, and/or the presence of other important features such as water bodies, rocks, and ground litter. The unique biogeographic and evolutionary history of each species also influences its current distribution.

Our preliminary work indicates that small mammals (of four species) were somewhat more abundant in herbaceous vegetation types than in forest and scrub types (Figure 4, 5). Cinereus shrews were exceptionally numerous during the time of our study and relatively evenly distributed across the range of vegetation types sampled (Table 4). Montane shrews were considerably less numerous and somewhat more prevalent in herbaceous habitats. Red-backed voles, the dominant but nowhere abundant small rodent species in 2003, were sampled across the range of major vegetation types, but were relatively less numerous in scrub habitats. Tundra voles, whose population levels also appeared to be exceptionally low during this inventory, were generally restricted to open scrub and herbaceous habitats.

Summary and Significance

The small mammal fauna of KEFJ in particular, and the Kenai Peninsula in general, has been little studied and remains poorly documented. Given the rapid expansion of this region's human populations, their accompanying impacts, and what may be a major shift in climate now underway, it is imperative that we begin to base management and scientific decisions on sound, well documented knowledge and strongly substantiated taxonomic (and historic) frameworks.

This specimen-based inventory begins to rectify this situation through the process of documenting the assemblage of approximately 26 land mammals that inhabit KEFJ. Among the Park's small mammals, only 4 of 14 potential species are now documented with specimens. Cinereus shrew was the most frequently captured small mammal, accounting for over 60% of total trapline transect samples. Three other species—Northern red-backed vole, montane shrew, and tundra vole—made up the remaining 40% of total captures. Hoary marmots and red squirrels were encountered in a number of localities, but no samples were taken due to permit restrictions.

The Kenai Peninsula has repeatedly been suggested as an area of increased endemism. As such, there is high potential for distinctive populations or subspecies. The taxonomic status of these species must be investigated before state and federal agencies can effectively prioritize resources for their management. Most of these unique taxa were described years ago and are in need of revision using larger samples sizes and modern techniques. Subspecies currently considered endemic to the Peninsula are as follows:

- red squirrel, *T. h. kenaiensis* (A. H. Howell 1936. Proc. Biol. Soc. Washington, 49:136).

- wolf, *C. l. alces* (Goldman 1941. Proc. Biol. Soc. Washington, 54:109).
- red fox, *V. v. kenaiensis* (Merriam 1900. Proc. Wash. Acad. Sci., 2:670).
- marten, *M. a. kenaiensis* (Elliot 1903. Field. Columb. Mus., Publ. 72, Zool. Ser., 3:151).
- wolverine, *G. g. katschemakensis* (Matschie 1918. Gesell. Naturforsch. Freunde, Berlin, page 151).
- black bear, *U. a. perniger* (J. A. Allen 1910. Bull. Amer. Mus. Nat. Hist., 28:6).
- Dall's sheep, *O. d. kenaiensis* (J. A. Allen 1902. Bull. Amer. Mus. Nat. Hist., 16:145).

The Kenai Peninsula is also the type locality for several other, more wide-ranging taxa, namely:

- singing vole, *M. m. miurus* (Osgood 1901. N. Amer. Fauna, 21:64).
- moose, *A. a. gigas* (Miller 1899. Proc. Biol. Soc. Washington, 13:57).
- caribou, formerly *R. stonei* (J. A. Allen 1901. Bull. Amer. Mus. Nat. Hist., 14:143), now subsumed under *R. t. granti* (J. A. Allen 1902. Bull. Amer. Mus. Nat. Hist., 16:122). The native population of caribou were extirpated from the Kenai Peninsula by about 1913 (Spencer and Hakala 1964).
- brown bear, formerly *U. kenaiensis* (Merriam 1904. Proc. Biol. Soc. Wash., 17:154), now subsumed under *U. a. alascensis* (Merriam, 1896. Proc. Biol. Soc. Wash., 10:74).
- mink, *M. v. melampeplus* (Elliot 1903. Field. Columb. Mus., Publ. 72, Zool. Ser., 3:170).

The Kenai Peninsula has a relatively depauperate mammal fauna in comparison to “mainland” southcentral Alaska. The narrow, 16 km-wide connection of land between these two land masses at the head of Turnagain Arm has apparently acted as an effective barrier to cross-colonization. Mainland mammals whose distributions terminate north of Turnagain Arm include:

- tundra shrew (*Sorex tundrensis*)
- water shrew (*Sorex palustris*)
- meadow vole (*Microtus pennsylvanicus*) (but see Fuller 1981)
- brown lemming (*Lemmus trimucronatus*)
- arctic ground squirrel (*Spermophilus parryii*)
- least weasel (*Mustela nivalis*)
- collared pika (*Ochotona collaris*).

Two mainland species may be present on the Kenai Peninsula (meadow jumping mouse, *Zapus hudsonius*, and northern flying squirrel, *Glaucomys sabrinus*), but we lack information to verify their occurrence there.

In the case of the jumping mouse, no specimens from the Kenai Peninsula exist in any museum collections or are referenced in the literature (e.g, Krutzsch 1954, Jones 1981). The one plausible report of this species' occurrence on the

Peninsula is that of Osgood (1901). He mentioned a credible description of a jumping mouse that was seen by a miner at Hope several years prior to his visit there in 1900. With hopes to rectify this situation, our field crew trapped intensively in prime-looking jumping mouse habitats in the Sterling and Portage Creek areas for a number of days in late July, 2003, but without success.

The status of the northern flying squirrel is similarly unclear. ADFG (1978) included the entire Kenai Peninsula within the range of this species and noted that flying squirrels have been recorded as occurring (no details given). No specimens of this species exist in collections from the Kenai Peninsula. Manville and Young (1965) denoted a specimen record in the USNM from apparently the Ninilchik area; however, our search at the National Collection for this specimen proved unsuccessful.

Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) were transplanted to several islands in Prince William Sound (PWS) from Sitka from 1917 through 1923 (Burris and McKnight 1973). This effort proved successful and resulted in the spread of deer throughout the islands and, to a lesser extent, along the mainland, including the westernmost coast of the Kenai Peninsula (ADFG 1973). In subsequent years, there have been a number of unconfirmed reports of deer and tracks farther along the outer coast west of Cape Fairchild (ADFG 1973), and across from PWS at the head of Turnagain Arm as far west as Anchorage (Kenai Peninsula Online 2002).

The most valuable product of this and any inventory is the collection of well-documented and diverse preparations of scientific specimens.

Why specimens? As elucidated by Reynolds et al. (1996), voucher specimens and corresponding data assembled during field surveys of mammals are critical for accurate identification of the animals studied and for verification of the data gathered and reported as resulting from the investigation. Voucher specimens are particularly valuable for studies of the smaller species that are difficult to identify (e.g., shrews, *Microtus* voles) and often poorly known (most Alaska small mammals).

Long after the original inventory is completed, voucher specimens and their associated materials will be used for a wide array of studies such as taxonomic revisions, biogeographic and conservation studies (e.g., Cook and MacDonald 2001), evolutionary studies (Cook et al. 2001), parasitology (e.g., Hoberg et al. 2003), and epidemiology (e.g., Goethert et al. ms).

Voucher specimens also provide critical historical baseline for assessment of change caused by natural or human perturbations. As they represent historical populations, the value of large series of specimens increases through time, particularly as the diversity of many localities is degraded. Solid inventories of federal lands has become increasingly important as these lands often are now

used to establish baseline conditions for investigations aimed at documenting anthropogenic influences and other impacts responsible for environmental change. Lessons learned from the Exxon Valdez disaster just east of KEFJ in Prince William Sound suggest that baseline data are critical to interpretation of impacts. With PCR (polymerase chain reaction) and other innovations in the study of DNA, we now can examine and monitor genetic variation in populations of animals that were collected during different time periods; thus providing a more rigorous view of temporal genetic variation and population structure. For example, known contact zones between taxa can now be reanalyzed for temporal stability (but only if specimens from the contact zone were collected at regular intervals). Because of the dynamic geologic history of Alaska and the role that glaciers played in the distribution of organisms, these kinds of studies are essential to documenting and managing biodiversity. Recent concern with Persistent Organic Pollutants (POPS) combined with rapid technological innovation with regard to our ability to track POPS, further enhances the utility of these specimens in such crucial areas of study such as monitoring environmental quality. Given the proximity of KEFJ to major industrialized activities such as oil extraction and processing and mining, the baseline these specimens provide may indeed become critical to future NPS initiatives.

Without the preservation of specimens, inventories such as this one would have extremely limited value (either short-term or long-term). Federal tax dollars used for biodiversity assessments are most efficiently spent if agencies recognize the critical need for vouchers and provide support in both field and museum budgets for their preservation and maintenance (Reynolds et al. 1996).

While the importance of museum specimens should be generally recognized and their preparation considered essential to good science, for many the question remains: Why collect so many specimens?

Some perspectives:

- Alaska mammalogy is still in the early exploration phase. For most species of Alaska mammals, many areas, including KEFJ and the Kenai Peninsula, are poorly known and inadequately represented in systematic collections. This point is acutely apparent when recent phylogeographic studies are reviewed (e.g., Fleming and Cook 2002; Stone et al. 2002; Fedorov et al. 2003).
- Small numbers of specimens will not adequately represent the inherent morphologic, genetic, and parasitic variation that exists within and among populations. Rigorous and statistically defensible scientific studies require large samples of well-preserved (and diverse) materials to account for age, sex, geographic, and/or individual variation. Taxonomic studies based on skull morphology may require undamaged material from 20 or more adult individuals of each sex per locality (i.e., a minimum of 40 adult individuals per population).
- Many of the shrews and small rodents are difficult or impossible to identify except through the careful study of specimens. Close examination of tooth

pattern and comparison of body measurements and other characters are necessary to distinguish most of Alaska's shrews. Voles of the genus *Microtus* can also be especially difficult to differentiate.

- Considerable sampling effort is needed to document the rare and uncommon species.
- The number of animals removed from a population only has biological significance if it is related to the total number of animals in the population and their rate of replacement (Reynolds et al. 1996). Because Alaska's small mammals are short-lived and prolific, their reproductive potential is more than sufficient to accommodate low levels of removal through the sampling methods used in these inventory projects.

Recommendations for Future Inventory and Monitoring Efforts

1. Inventory studies must be viewed as an ongoing process and NPS must remain committed to continue the efforts begun in these initial inventories. Future monitoring efforts should include a sampling regime that regularly vouchers diverse preparations (specimens) of representative species. This initial inventory has set the stage for additional collaborative efforts to fully document the mammal fauna of the KEFJ.
2. Singing vole, pygmy shrew, muskrat, snowshoe hare, and northern bog lemming have yet to be documented from within the boundaries of KEFJ. The most likely areas to continue the search for these species are along the Resurrection River and at the headwaters of the Nuka River.
3. We strongly encourage the expansion of cooperative efforts to fully document the small mammal fauna of the entire Kenai Peninsula. Even among the now documented species, nearly all still lack adequate numbers of samples for conducting studies and making sound management decisions. What is status of northern flying squirrels, meadow jumping mice, and a number of other species on the Peninsula?
4. The taxonomic relationships among many of the Kenai Peninsula's taxa are in need of a re-evaluation using modern techniques and much larger sample sizes.
5. The unique fauna of the Kenai Peninsula offers unprecedented opportunities for an array of studies that relate the dynamic glacial history of the region (and the possibility of persistent refugia; Elias 1995) to the evolution and geography of its biota. The systematic relationships among endemic taxa have been particularly problematic and are in need of further research efforts. Such investigations must be based on adequate series of diverse and well-preserved specimens. Considerable interest in the effects of climate change on biotic diversity suggests that studies of the fauna and flora of KEFJ and the Kenai Peninsula could be key to understanding these impacts.

Acknowledgments

A project of this kind involved the hard work and diverse talents of many. Our special thanks to Eric Waltari (ISU), Anson Koehler (UNM), and Carlee Hengel (ISU) for their diligence and camaraderie in the field, and to Bill Leacock (NPS-I&MP) along with skipper Kevin Murphy, Emily Horrell, Eric Groth, and Lucretia Fairchild of the MV Serac for providing excellent logistic support. We also extend our thanks to Bud Rice, Ian Martin, Amy Wright, and at NPS for their assistance and counsel, to Rob Lipkin and others with Alaska Heritage-Anchorage, to Paul Packard and Marisol Tapia, both coming and going, and to Brandy Jacobsen, Dr. Gordon Jarrell, and Dusty McDonald of the UAM's Mammal Collection, and to others not listed above.

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Table 1a. Checklist of the land mammals of *Kenai Fjords National Park*, Alaska. Current status: ● = present and substantiated with vouchered specimen; ○ = species of known or probable, but unverified, occurrence; ? = status unknown.

INSECTIVORA - Shrews

Family **Soricidae**

- *Sorex cinereus*, cinereus shrew
- *S. monticolus*, montane shrew
- *Sorex hoyi*, pygmy shrew

CHIROPTERA - Bats

Family **Vespertilionidae**

- *Myotis lucifugus*, little brown bat

CARNIVORA - Carnivores

Family **Canidae**

- *Canis latrans*, coyote
- *Canis lupus*, wolf
- ? *Vulpes vulpes*, red fox

Family **Felidae**

- *Lynx canadensis*, Canada lynx

Family **Mustelidae**

- *Gulo gulo*, wolverine
- *Lontra canadensis*, northern river otter
- *Martes americana*, American marten
- *Mustela erminea*, ermine
- *Mustela vison*, American mink

Family **Ursidae**

- *Ursus americanus*, American black bear
- *Ursus arctos*, brown bear

ARTIODACTYLA - Ungulates

Family **Cervidae**

- *Alces alces*, moose
- ? *Rangifer tarandus*, caribou

Family **Bovidae**

- *Oreamnos americanus*, mountain goat
- ? *Ovis dalli*, Dall's sheep

RODENTIA - Rodents

Family **Sciuridae**

- *Marmota caligata*, hoary marmot
- *Tamiasciurus hudsonicus*, red squirrel

Family **Castoridae**

- *Castor canadensis*, American beaver

Family **Muridae**

- *Clethrionomys rutilus*, northern red-backed vole
- *Microtus miurus*, singing vole
- *M. oeconomus*, tundra vole
- *Ondatra zibethicus*, muskrat
- *Synaptomys borealis*, northern bog lemming

Family **Erethizontidae**

- *Erethizon dorsatum*, North American porcupine

LAGOMORPHA - Pikas & Hares

Family **Leporidae**

- *Lepus americanus*, snowshoe hare

Table 1b. Checklist of the land mammals of Kenai Peninsula, Alaska. Current status: ● = present and substantiated with vouchered specimen; ○ = species of known or probable, but unverified, occurrence; ? = status unknown.

INSECTIVORA - Shrews

Family **Soricidae**

- *Sorex cinereus*, cinereus shrew
- *S. monticolus*, montane shrew
- *Sorex hoyi*, pygmy shrew
- ? *Sorex palustris*, water shrew

CHIROPTERA - Bats

Family **Vespertilionidae**

- *Myotis lucifugus*, little brown bat

CARNIVORA - Carnivores

Family **Canidae**

- *Canis latrans*, coyote
- *Canis lupus*, wolf
- *Vulpes vulpes*, red fox

Family **Felidae**

- *Lynx canadensis*, Canada lynx

Family **Mustelidae**

- *Gulo gulo*, wolverine
- *Lontra canadensis*, northern river otter
- *Martes americana*, American marten
- *Mustela erminea*, ermine
- *Mustela vison*, American mink

Family **Ursidae**

- *Ursus americanus*, American black bear
- *Ursus arctos*, brown bear

ARTIODACTYLA - Ungulates

Family **Cervidae**

- *Alces alces*, moose
- *Odocoileus hemionus sitkensis*, Sitka b-t deer
- *Rangifer tarandus*, caribou

Family **Bovidae**

- *Oreamnos americanus*, mountain goat
- *Ovis dalli*, Dall's sheep

RODENTIA - Rodents

Family **Sciuridae**

- *Marmota caligata*, hoary marmot
- *Tamiasciurus hudsonicus*, red squirrel
- ? *Glaucomys sabrinus*, Northern flying squirrel

Family **Castoridae**

- *Castor canadensis*, American beaver

Family **Dipodidae**

- ? *Zapus hudsonius*, meadow jumping mouse

Family **Muridae**

- *Clethrionomys rutilus*, northern red-backed vole
 - *Microtus miurus*, singing vole
 - *M. oeconomus*, tundra vole
 - ? *Microtus pennsylvanicus*, meadow vole
 - *Ondatra zibethicus*, muskrat
 - *Synaptomys borealis*, northern bog lemming
- Family **Erethizontidae**
- *Erethizon dorsatum*, North American porcupine

LAGOMORPHA - Pikas & Hares

Family **Leporidae**

- *Lepus americanus*, snowshoe hare

Table 2. Number of small mammals sampled at 10 general localities, *Kenai Fjords National Park*, Alaska, July 2003.

SPECIES	LOCALITY										TOTALS
	Upper Nuka River	North Arm Nuka Bay	Shelter Cove, Beauty Bay	Delight Spit	Delight Lake	Paguna Arm	Crater Bay	North-western Lagoon	Aialik Bay	Resurrection River	
SHREWS											
<i>Sorex cinereus</i>	48	61	23	60	63	67	4	11	41	80	458
<i>S. monticolus</i>	6		6	13	7	4	2	13		6	57
RODENTS											
<i>Clethrionomys rutilus</i>	5	10	14	7	7	31	6	6	69	48	203
<i>Microtus oeconomus</i>	4	3				10			13		30
TOTAL # SPECIMENS	63	74	43	80	77	112	12	30	123	134	748
TOTAL # SPECIES	4	3	3	3	3	4	3	3	3	3	4
TOTAL TRAPNIGHTS	478	350	215	500	750	623	175	334	636	512	4573

Table 3. Trapline transects for sampling small mammals in *Kenai Fjords National Park*, Alaska, July 2003.

GENERAL LOCALITY Kenai Fjords NP	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES	VEGETATION TYPE
Upper Nuka River	1	59°37'37"	150°40'24"	300	200	8-10 July 2003	200	21 <i>Sorex cinereus</i> , 4 <i>S. monticolus</i> , 3 <i>Clethrionomys rutilus</i> , 2 <i>Microtus oeconomus</i>	Dry Forb Herbaceous: forbs plus some grass, tall willow, rock and low alder edge
	2	59°37'35"	150°40'05"	330	800	8-10 July 2003	196	22 <i>Sorex cinereus</i> , 2 <i>S. monticolus</i> , 2 <i>Clethrionomys rutilus</i> , 2 <i>Microtus oeconomus</i>	Open Low Scrub: talus edge, primarily forbs, 2-3 ft. willow, low alder edge
	3	59°37'40"	150°40'13"	300	200	8-10 July 2003	82	5 <i>Sorex cinereus</i>	Open Low Scrub: low forbs with grasses, buttercups, lupine and 2-3 ft. willow
North Arm, Nuka Bay	1	59°33'45"	150°31'20"	3	250	7-9 July 2003	300	43 <i>Sorex cinereus</i> , 7 <i>Clethrionomys rutilus</i> , 3 <i>Microtus oeconomus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow along spruce forest edge
	2	59°33'45"	150°31'20"	5	100	10-11 July 2003	50	18 <i>Sorex cinereus</i> , 3 <i>Clethrionomys rutilus</i>	Closed Needleleaf Forest
Shelter Cove, Beauty Bay	1	59°31'12"	150°38'25"	12	200	9-10 July 2003	215	23 <i>Sorex cinereus</i> , 6 <i>S. monticolus</i> , 14 <i>Clethrionomys rutilus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow along spruce forest edge
Delight Spit	1	59°32'43"	150°20'08"	10	300	11-15 July 2003	500	60 <i>Sorex cinereus</i> , 13 <i>S. monticolus</i> , 7 <i>Clethrionomys rutilus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow partially along spruce forest edge
Delight Lake	1	59°32'35"	150°18'43"	10	200	11-13 July 2003	200	16 <i>Sorex cinereus</i> , 3 <i>S. monticolus</i> , 1 <i>Clethrionomys rutilus</i>	Open Needleleaf Forest: edge of lake in sitka spruce, devil's club, moss, forbs, with alder, will shrubs
	2	59°32'42"	150°19'36"	5	200	12-14 July 2003	200	20 <i>Sorex cinereus</i> , 4 <i>Clethrionomys rutilus</i>	Open Needleleaf Forest: cliff edge with sitka spruce, devil's club, <i>Viburnum</i> , mosses, forbs, 5-8 ft. alder
	3	59°32'51"	150°19'45"	2	350	12-15 July 2003	350	27 <i>Sorex cinereus</i> , 4 <i>S. monticolus</i> , 2 <i>Clethrionomys rutilus</i>	Mixed Woodland: forest/ sedge meadow edge with devil's club, 5-8 ft. alder, sitka spruce, moss, fireweed
Paguna Arm	1	59°41'38"	150°08'02"	2	500	16-17 July 2003	60	22 <i>Sorex cinereus</i> , 3 <i>S. monticolus</i> , 9 <i>Clethrionomys rutilus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow partially along spruce forest edge

Table 3. Trapline transects for sampling small mammals in *Kenai Fjords National Park*, Alaska, July 2003.

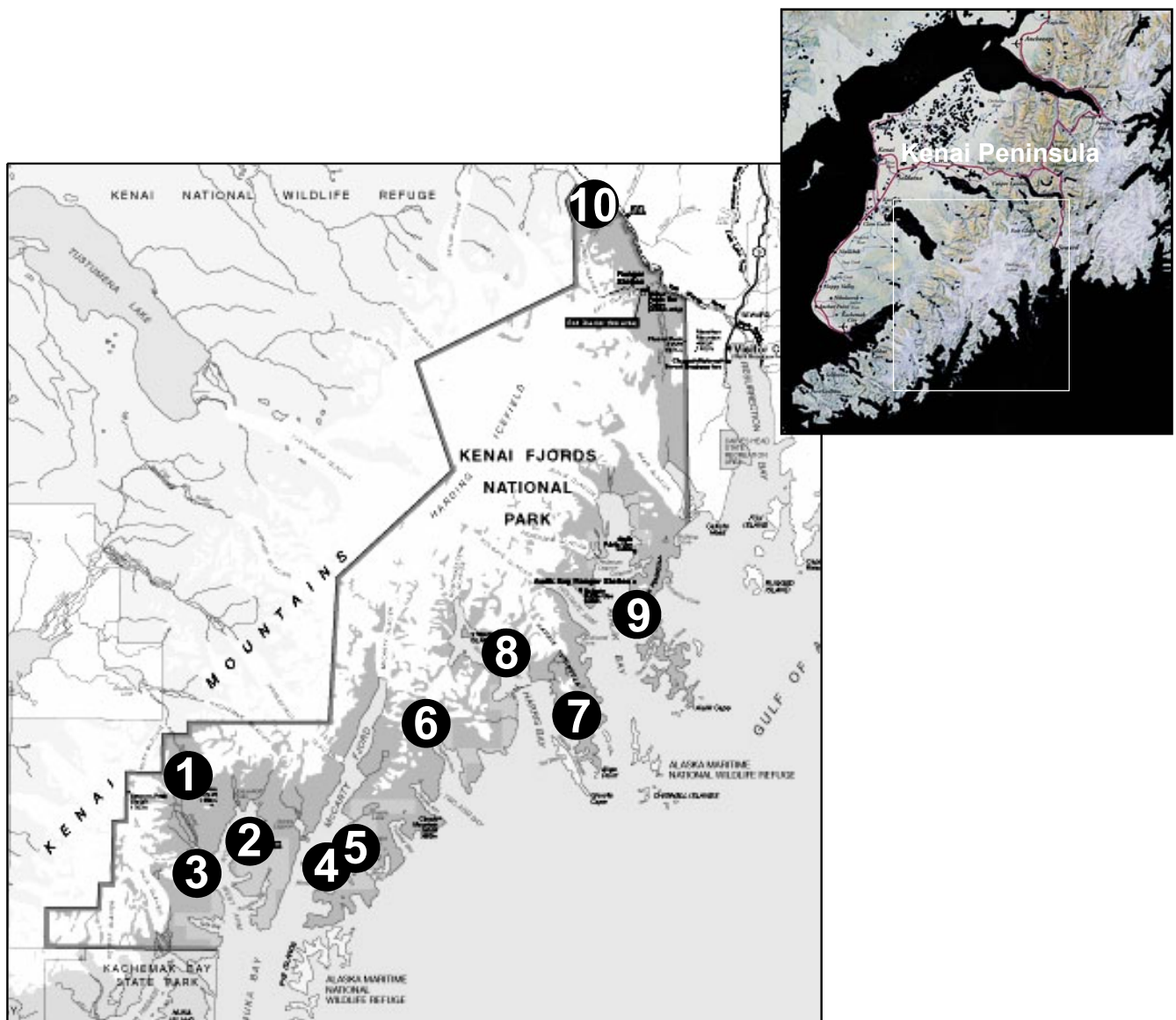
GENERAL LOCALITY Kenai Fjords NP	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES	VEGETATION TYPE
	2	59°41'38"	150°08'02"	2	500	16-17 July 2003	120	22 <i>Sorex cinereus</i> , 1 <i>S. monticolus</i> , 6 <i>Clethrionomys rutilus</i>	Closed Needleleaf Forest: with dense thickets of alder
	3	59°40'38"	150°05'49"	3	500	16-17 July 2003	164	10 <i>Sorex cinereus</i> , 4 <i>Clethrionomys rutilus</i> , 7 <i>Microtus oeconomus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow with <i>Festuca</i> , alder shrub
	4	59°40'38"	150°05'49"	3	500	16-18 July 2003	204	12 <i>Sorex cinereus</i> , 8 <i>Clethrionomys rutilus</i> , 2 <i>Microtus oeconomus</i>	Open Needleleaf Forest: mature spruce
	5	59°41'40"	150°08'52"	130	200	17-18 July 2003	75	1 <i>Sorex cinereus</i> , 4 <i>Clethrionomys rutilus</i> , 1 <i>Microtus oeconomus</i>	Open Tall Scrub: alpine meadow/talus slope edge with alder, grasses, <i>Veratrum</i>
Crater Bay	1	59°43'	149°46'30"	200	500	18-19 July 2003	50	3 <i>Sorex cinereus</i> , 3 <i>Clethrionomys rutilus</i>	Alpine tundra
	2	59°41'30"	149°47'00"	5-15	500	18-19 July 2003	125	1 <i>Sorex cinereus</i> , 2 <i>S. monticolus</i> , 3 <i>Clethrionomys rutilus</i>	Close mature spruce Forest
Northwestern Lagoon	1	59°46'25"	149°55'28"	5	200	19-20 July 2003	70	6 <i>Sorex cinereus</i> , 1 <i>S. monticolus</i> , 1 <i>Clethrionomys rutilus</i>	Open Low Scrub: willow wetland area
	2	59°46'12"	149°55'34"	5	200	19-20 July 2003	144	2 <i>Sorex cinereus</i> , 7 <i>S. monticolus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow with <i>Festuca</i> , alder and willow
	3	59°46'19"	149°55'22"	5	200	19-20 July 2003	50	1 <i>Sorex cinereus</i> , 3 <i>S. monticolus</i> , 1 <i>Clethrionomys rutilus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow/alder edge
	4	59°46'25"	149°55'11"	230	10	19-20 July 2003	70	2 <i>Sorex cinereus</i> , 2 <i>S. monticolus</i> , 2 <i>Clethrionomys rutilus</i>	Closed Needleleaf Forest: spruce
Aialik Bay, Tooth Cove	1	59°49'03"	149°38'24"	10	300	20-22 July 2003	80	12 <i>Sorex cinereus</i> , 10 <i>Clethrionomys rutilus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow/alder edge
	2	59°49'03"	149°38'24"	10-20	500	20-22 July 2003	80	1 <i>Sorex cinereus</i> , 12 <i>Clethrionomys rutilus</i> , 1 <i>Microtus oeconomus</i>	Mesic Graminoid Herbaceous: hillside meadow near alder thickets
	3	59°49'03"	149°38'24"	10	500	20-22 July 2003	160	10 <i>Sorex cinereus</i> , 10 <i>Clethrionomys rutilus</i> , 8 <i>Microtus oeconomus</i>	Dry-Wet Graminoid Herbaceous: hillside meadow with occasional alders
Aialik Bay, "South Tooth Cove"	1	59°48'23"	149°38'38"	10	500	20-22 July 2003	80	5 <i>Sorex cinereus</i> , 11 <i>Clethrionomys rutilus</i> , 3 <i>Microtus oeconomus</i>	Dry Graminoid Herbaceous: <i>Elymus</i> estuarine meadow near alder edge
	2	59°48'23"	149°38'38"	10	500	20-22 July 2003	80	4 <i>Sorex cinereus</i> , 14 <i>Clethrionomys rutilus</i>	Dry Graminoid Herbaceous/Low Scrub slope

Table 3. Trapline transects for sampling small mammals in *Kenai Fjords National Park*, Alaska, July 2003.

GENERAL LOCALITY Kenai Fjords NP	LINE #	N LATITUDE	W LONGITUDE	ELEV (M)	MAX ERROR (M)	DATE	# TRAP NIGHTS	# CAPTURES BY SPECIES	VEGETATION TYPE
	3	59°48'23"	149°38'38"	10	500	20-22 July 2003	156	5 <i>Sorex cinereus</i> , 11 <i>Clethrionomys rutilus</i> , 3 <i>Microtus oeconomus</i>	Dry Graminoid Herbaceous/Tall-Low Scrub
Resurrection River	1	60°17'02"	149°42'50"	160	200	25-27 July 2003	120	25 <i>Sorex cinereus</i> , 2 <i>S. monticolus</i> , 3 <i>Clethrionomys rutilus</i>	Mesic Graminoid Herbaceous: upland bog meadow near edge of spruce forest
	2	60°17'03"	149°42'37"	160	200	25-26 July 2003	120	9 <i>Sorex cinereus</i> , 16 <i>Clethrionomys rutilus</i>	Close Needleleaf Forest: spruce
	3	60°17'10"	149°42'39"	150	200	25-26 July 2003	50	8 <i>Sorex cinereus</i> , 2 <i>S. monticolus</i> , 8 <i>Clethrionomys rutilus</i>	Close Broadleaf Forest: some spruce with thick alders
	4	60°17'10"	149°42'39"	150	200	25-26 July 2003	50	6 <i>Sorex cinereus</i> , 1 <i>S. monticolus</i> , 10 <i>Clethrionomys rutilus</i>	Closed Needleleaf Forest: spruce
	5	60°16'54"	149°42'34"	170	200	25-27 July 2003	160	19 <i>Sorex cinereus</i> , 2 <i>Clethrionomys rutilus</i>	Open Low Scrub: dwarf birch, <i>Ledum</i> , <i>Vaccinium</i> , sedges
	6	60°16'59"	149°42'40"	170	200	25-26 July 2003	80	7 <i>Sorex cinereus</i> , 7 <i>Clethrionomys rutilus</i>	Close Needleleaf Forest: spruce, hemlock, alder, moss
	7	60°17'02"	149°42'45"	160	200	26-27 July 2003	30	6 <i>Sorex cinereus</i> , 1 <i>S. monticolus</i> , 2 <i>Clethrionomys rutilus</i>	Close Needleleaf Forest: spruce, hemlock, moss along stream

Table 4. Relative abundance (captures/100 trap nights) of small mammals in three major vegetation types, *Kenai Fjords National Park*, July 2003.

SPECIES	FOREST	SCRUB	HERBACEOUS
Shrews			
<i>Sorex cinereus</i>	9.34	6.00	10.13
<i>S. monticolus</i>	0.97	0.51	1.56
Small Rodents			
<i>Clethrionomys rutilus</i>	4.37	1.54	4.88
<i>Microtus oeconomus</i>	0.12	0.51	1.11
All Species	14.80	8.58	17.67
Trap Nights	1649	583	2439



SAMPLING LOCALITIES

1. Upper Nuka River (59.6167N, 150.6667W [NAD27]): 8-10 July 2003
2. North Arm, Nuka Bay (59.55N, 150.5167W [NAD27]): 7-11 July 2003
3. Shelter Cove, Beauty Bay (59.5167N, 150.6333W [NAD27]): 9-10 July 2003
4. Delight Spit (67.1N, 154.2667W [NAD27]): 11-15 July 2003
5. Delight Lake (59.5333N, 150.3W [NAD27]): 11-15 July 2003
6. Paguna Arm (59.6833N, 150.1333W [NAD27]): 16-18 July 2003
7. Crater Bay (59.7167N, 149.7667W [NAD27]): 18-19 July 2003
8. Northwestern Lagoon (59.7667N, 149.9167W [NAD27]): 19-20 July 2003
9. Aialik Bay (59.8167N, 149.6333W [NAD27]): 20-22 July 2003
10. Resurrection River (60.2833N, 149.7W [NAD27]): 25-28 July 2003

Figure 1. General localities in *Kenai Fjords National Park*, Kenai Peninsula, Alaska, sampled for small mammals in 2003.

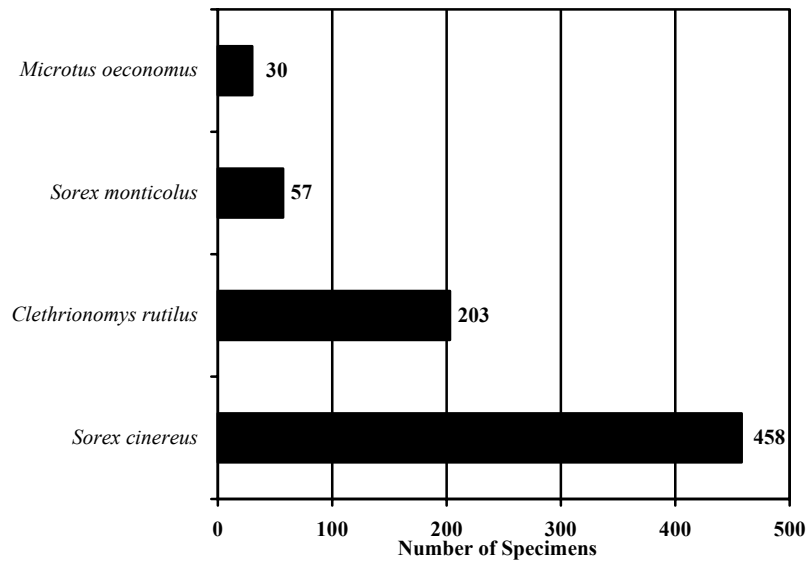


FIGURE 2. Number of shrews and murid rodents sampled in *Kenai Fjords National Park*, Alaska, during field season 2003.

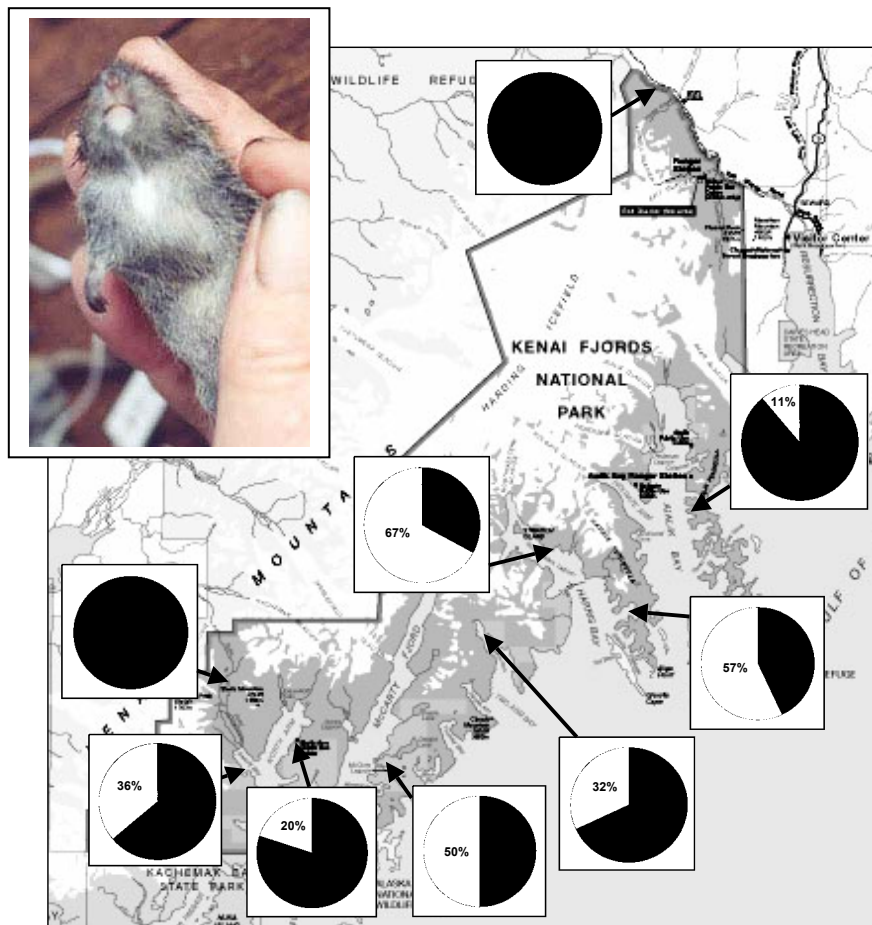


FIGURE 3. Proportion (percent) of *Clethrionomys rutilus* samples by general locality with white chin, throat or belly marking, *Kenai Fjords National Park*, Alaska, July 2003.

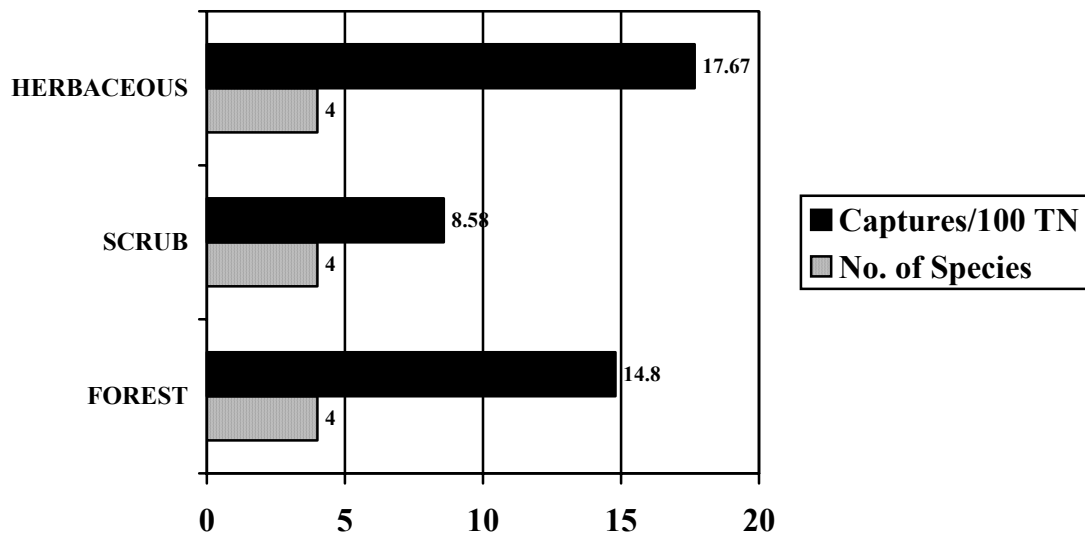


FIGURE 4. Relative abundance (captures/100 trap nights) and species richness of shrews and murid rodents in major vegetation types, *Kenai Fjords National Park*, Alaska, July 2003.

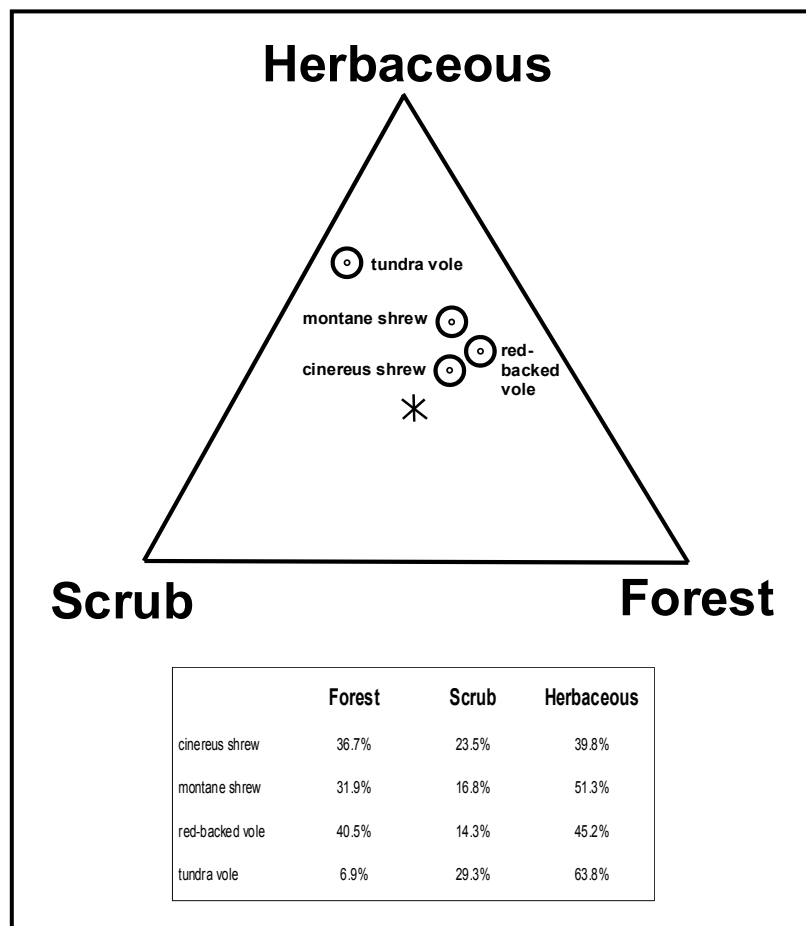


Figure 5. Proportion (per cent) of small mammal captures in major vegetation types, *Kenai Fjords National Park*, Alaska, July 2003.